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(71) Applicant (*for all designated States except US*): **EBARA CORPORATION** [JP/JP]; 11-1, Haneda Asahi-cho, Ohta-ku, Tokyo 144-8510 (JP).

(72) Inventors; and
(75) Inventors/Applicants (*for US only*): **NOSE, Hiroya** [JP/JP]; c/o Ebara Corporation, 11-1, Haneda Asahi-cho, Ohta-ku, Tokyo 144-8510 (JP). **WATANABE, Kazuaki** [JP/JP]; c/o Ebara Corporation, 11-1, Haneda Asahi-cho, Ohta-ku, Tokyo 144-8510 (JP). **KOJIMA, Toshio** [JP/JP]; c/o Ebara Corporation, 11-1, Haneda Asahi-cho, Ohta-ku, Tokyo 144-8510 (JP). **KOSUGI, Shigeru** [JP/JP]; c/o Ebara Corporation, 11-1, Haneda Asahi-cho, Ohta-ku, Tokyo 144-8510 (JP). **ANDO, Tetsuya** [JP/JP]; c/o Ebara Corporation, 11-1, Haneda Asahi-cho, Ohta-ku, Tokyo 144-8510 (JP).

(74) Agents: **WATANABE, Isamu** et al.; GOWA Nishi-Shinjuku 4F, 5-8, Nishi-Shinjuku 7-chome, Shinjuku-ku, Tokyo 160-0023 (JP).

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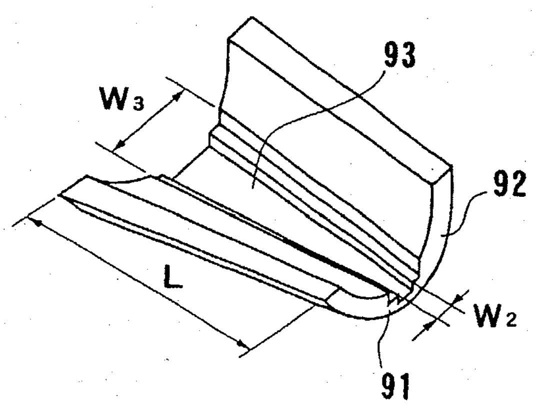
(54) Title: SLAGGING COMBUSTION FURNACE



(57) Abstract: A gasification and slagging combustion system comprises a gasification furnace (2) for gasifying wastes at a relatively low temperature, and a slagging combustion furnace (7) for combusting a gas and char produced by the gasification furnace (2) at a high temperature. The slagging combustion furnace (7) comprises combustion chambers (8, 9, 10) for combusting a gas produced by the gasification furnace (2) at a high temperature. A slag discharge port (11) is provided at a bottom portion (91) of the combustion chamber (9) for discharging molten slag produced by combustion at a high temperature. An introducing groove (93) is provided at the bottom portion (91) of the combustion chamber (9) for introducing the molten slag flowing downwardly on the bottom portion (91) into the slag discharge port (11). The introducing groove (93) has a passage which is reduced in width gradually from the upstream side of the bottom portion (91) toward the slag discharge port (11).

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DESCRIPTION

SLAGGING COMBUSTION FURNACE

Technical Field

The present invention relates to a gasification and slagging combustion system and a slagging combustion furnace suitable for use in such a gasification and slagging combustion system, and more particularly to a gasification and slagging combustion system for completely combusting wastes without generating dioxins by gasification and slagging combustion to melt ash content contained in the wastes into slag which can efficiently be recovered, and a slagging combustion furnace suitable for use in such a gasification and slagging combustion system. The present invention also relates to a swirling-type slagging combustion furnace, and more particularly to a swirling-type slagging combustion furnace for combusting a gas which is produced by pyrolysis gasification of wastes at a low temperature in a gasification furnace, at a high temperature to melt ash content contained in the produced gas, such wastes comprising municipal wastes, refuse-derived fuel (RDF), plastic wastes, waste fiber-reinforced plastics (waste FRP), biomass wastes, automobile wastes, waste oil, shredder dusts, or the like.

Background Art

A gasification and slagging combustion system (gasification and combustion fusion system) which is a combination of pyrolysis gasification and high-temperature combustion has been put into practical use as a new waste treatment system substituting for incineration. Such a gasification and slagging combustion system has been proposed by the applicant, as disclosed in the Japanese laid-open Patent Publication No. 11-241817, for example. Here, the

gasification and slagging combustion system is defined as a system in which wastes are gasified at a relatively low temperature to produce combustible gas in a gasification furnace and the produced combustible gas is combusted at a relatively high temperature to generate exhaust gas and ash contained in the combustible gas is melted to produce slag in a slagging combustion furnace (combustion fusion furnace). The gasification and slagging combustion system is used for wastes such as municipal wastes, refuse-derived fuel, solid-water mixtures, plastic wastes, waste fiber-reinforced plastics (waste FRP), biomass wastes, automobile wastes, paper sludges, medical wastes, or waste oil.

FIG. 5 is a perspective view showing a portion in the vicinity of a slag discharge port of a slagging combustion furnace in a gasification and slagging combustion system which is a combination of a fluidized-bed gasification furnace and a swirling-type slagging combustion furnace. The upper half of the slagging combustion furnace is cut away in FIG. 5. FIG. 6 is a cross-sectional view showing a portion in the vicinity of the slag discharge port of the slagging combustion furnace. In the swirling-type slagging combustion furnace, ash content contained in wastes is melted at a high temperature, and the molten ash content, i.e., molten slag is trapped on an inner wall of the furnace due to the centrifugal forces of the swirling flow in the furnace. The swirling-type slagging combustion furnace comprises a combustion chamber (not shown) and a slag discharge port 11. In FIG. 5, the bottom of the combustion chamber 9 is shown, and the bottom of the combustion chamber 9 is sloped at a gentle angle toward the slag discharge port 11. The molten slag trapped on the inner wall of the combustion chamber 9 slowly flows downwardly on the inner wall of the combustion chamber 9 and falls down from the slag discharge port 11 through a discharge chute 14 onto a water quenching

trough 15. Then, the molten slag is rapidly quenched by water in the water quenching trough 15. As shown in FIG. 5, the slag discharge port 11 has a rectangular shape.

However, the molten slag is liable to be solidified in the discharge chute 14, and the discharge chute 14 is liable to be clogged with the solidified slag. Particularly, in the case where the pyrolysis gasification furnace comprises a fluidized-bed furnace, the amount of fly ash generated is larger than that in a kiln and other furnaces. Additionally, in the case of wastes having a large amount of ash content, such as shredder dusts (automobile wastes), plating sludges, and solid wastes, the amount of molten slag is relatively larger. In such cases, the above problem becomes more significant. In FIG. 6, aggregated slag 17 having a shape like an icicle is formed beneath overhanging portions A of the slag discharge port 11. Such aggregated slag 17 is formed for the following reasons. Since the slag discharge port 11 has a rectangular shape, the molten slag flows downwardly into the water quenching trough 15 with streams having relatively large thicknesses at corners of the rectangular shape of the slag discharge port 11 and a number of thin streams at sides of the rectangular shape of the slag discharge port 11. Therefore, when the temperature is low at the portion in the vicinity of the slag discharge port 11, the molten slag loses its fluidity and is thus solidified. Accordingly, the molten slag flowing downwardly from the overhanging portions A of the slag discharge port 11 is cooled and lowered in fluidity in the vicinity of the slag discharge port 11. As a result, the aggregated slag 17 is formed and developed beneath the overhanging portions A of the slag discharge port 11.

FIG. 7 is a schematic view showing aggregated molten slag formed on the inner wall of the discharge chute. As described above, when the molten slag g flows downwardly from

the slag discharge port 11 through the discharge chute 14, aggregated slag having a shape like an icicle may be suspended from the tip of the overhanging portions A of the slag discharge port 11. In addition to this case, a number of streams of the molten slag may flow on the lower surface of the overhanging portions A and on an inner surface of the discharge chute 14. In this case, while flowing downwardly on the inner surface of the discharge chute 14, the molten slag is lowered in temperature to lose its fluidity, thus developing large aggregated slag 17 adhered to the inner wall of the discharge chute 14. Further, in the case where aggregated slag has a shape like an icicle, the tip of the icicle-like aggregated slag is vibrated by fluctuation of a gas flow therearound, and the flowing molten slag may be attached to the inner wall of the discharge chute 14, thus forming aggregated slag 17 on the inner wall of the discharge chute 14, as shown in FIG. 7.

The aggregated slag 17 thus generated is cooled so slowly that it becomes glassily solidified slag which is highly strong. Moreover, the aggregated slag 17 is firmly adhered to the inner wall of the discharge chute 14. Therefore, it is difficult to remove the aggregated slag 17 from the inner wall of the discharge chute 14. If the system is continuously operated in such a state, then the discharge chute 14 is fully clogged with the aggregated slag 17, and hence further operation cannot be continued. The development of the aggregated slag 17 becomes more significant as the amount of slag is larger, i.e., the amount of fly ash introduced from the gasification furnace is larger.

The structural materials constituting the slagging combustion furnace have been problematic in heat resistance to temperatures of 1300°C or higher and in corrosion-resistance to high temperature corrosion by sulfated matter or chloride. The slagging combustion furnace has been required to be made

of structural materials that can keep the durability and easiness of maintenance and repair of the inner wall of the furnace. Further, since no combustion gas flows through the discharge chute 14, a water-cooling jacket made of iron may be provided at the inner wall of the discharge chute 14. However, it has been proved that the water-cooling jacket is required to be made of a corrosion-resistant material because the environmental atmosphere is corrosive. Accordingly, highly durable steel such as stainless steel may be used for the water-cooling jacket. However, since highly durable steel is more expensive than iron material, when the water-cooling jacket is made of highly durable steel, manufacturing cost considerably rises.

As described above, in the conventional swirling-type slagging combustion furnace, a gas produced by pyrolysis gasification of wastes at a low temperature in the gasification furnace is combusted at a high temperature to melt solid components contained in the gas. Molten slag is discharged from the bottom of the swirling-type slagging combustion furnace. The discharged slag flows through the slag discharge chute (or duct) into a cooling device. The slag is cooled in the cooling device and then delivered to the exterior.

In the conventional swirling-type slagging combustion furnace, a cold gas flows upwardly from the cooling device through the slag discharge duct. Particularly, when the slag is cooled by water in the cooling device, water vapor is rapidly produced and flows upwardly as a cold gas. The cold gas ascends through the slag discharge duct and reaches a slag discharge port provided at the bottom of the swirling-type slagging combustion furnace to lower the temperature of the vicinity of the bottom of the swirling-type slagging combustion furnace to not more than a temperature required for melting ash content into slag. Thus, the temperature of the vicinity

of the slag discharge port in the swirling-type slagging combustion furnace is lowered to not more than a temperature required for melting ash content into slag. As a result, the slag tends to adhere to the portion in the vicinity of the slag discharge port, and hence the problem that it is difficult to stably discharge the slag from the swirling-type slagging combustion furnace may arise. Further, when the temperature of the vicinity of the slag discharge port is lowered, the clogging of the slag discharge port may occur, and an adverse effect on the flow of the slag flowing downwardly on the inner wall of the slagging combustion furnace may be caused.

Disclosure of Invention

The present invention has been made in view of the above drawbacks. It is therefore a first object of the present invention to provide a slagging combustion furnace and a gasification and slagging combustion system which can smoothly introduce molten slag produced by combustion at a high temperature into a slag discharge port, can prevent the molten slag from being attached to and developed on an inner wall of a discharge chute, and can smoothly discharge the molten slag from the slag discharge port and then cool the molten slag in water to form water-cooled slag.

A second object of the present invention is to provide a slagging combustion furnace and a gasification and slagging combustion system which utilize an optimal material as a structural material constituting the slagging combustion furnace from the viewpoints of corrosion-resistance and the cost.

A third object of the present invention is to provide a swirling-type slagging combustion furnace which can prevent a cold gas produced in a cooling device from lowering the temperature of the vicinity of a slag discharge port to not

more than a melting temperature, and can stably discharge slag.

In order to achieve the above first object, according to a first aspect of the present invention, there is provided a slagging combustion furnace comprising: a slagging combustion furnace comprising: a combustion chamber for combusting combustible gas and melting ash content contained in the combustible gas; a slag discharge port provided at a bottom portion of the combustion chamber for discharging molten slag produced by melting of the ash content; and an introducing groove provided at the bottom portion of the combustion chamber for introducing the molten slag flowing downwardly on the bottom portion into the slag discharge port, the introducing groove having a passage which is reduced in width gradually from the upstream side of the bottom portion toward the slag discharge port.

With the above arrangement, the molten slag produced by combustion at a high temperature is trapped on an inner wall of the slagging combustion furnace and flows downwardly on the bottom portion 91 of the slagging combustion furnace. Since the introducing groove 93 has a passage which is reduced in width gradually from the upstream side of the bottom portion toward the slag discharge port, the molten slag flowing downwardly on the bottom portion 91 is gathered together and then flows downwardly into the slag discharge port as one gathered steam or a bundle formed by gathering a small number of steams having a large thickness. Therefore, aggregated slag is prevented from being formed and developed in the discharge chute connected to the slag discharge port so as not to clog the discharge chute with the aggregated slag. Particularly, since the slag is prevented from flowing into the slag discharge port with a number of streams, the present invention is effective in the case where, as in a fluidized-bed gasification furnace, for example, the amount of char or fly

ash discharged together with the combustible gas is larger than that in other types of furnaces, or in the case where wastes supplied into the gasification furnace comprises shredder dusts (automobile wastes), refuse-derived fuel, plating sludges, paper sludges, wastes containing a large amount of ash content, e.g., biomass wastes such as hulls and corn dregs, particularly wastes containing ash content of 20 % to 30 % or more.

According to a second aspect of the present invention, there is provided a slagging combustion furnace comprising: a combustion chamber for combusting combustible gas and melting ash content contained in the combustible gas; and a slag discharge port provided at a bottom portion of the combustion chamber for discharging molten slag produced by melting of the ash content, the slag discharge port having a smooth shape for preventing the molten slag from stagnating thereon. The smooth shape may comprise at least one of a circular shape and an elliptical shape.

With the above arrangement, the molten slag flowing downwardly on the bottom portion 91 of the slagging combustion furnace 7 can smoothly flow downwardly without stagnating thereon. Therefore, even if the temperature of the discharge chute connected to the slag discharge port is lower than a temperature at which the molten slag is solidified, the molten slag is not cooled to a temperature at which the molten slag loses its fluidity. As a result, the molten slag flows downwardly through the discharge chute to prevent aggregated slag from being formed and developed in the discharge chute so as not to clog the discharge chute with the aggregated slag.

In order to achieve the above second object, according to a third aspect of the present invention, there is provided a slagging combustion furnace comprising: a combustion chamber for combusting combustible gas and melting

ash content contained in the combustible gas; a slag discharge port provided at a bottom portion of the combustion chamber for discharging molten slag produced by melting of the ash content; and a discharge chute having a water-cooling jacket for allowing the molten slag to pass therethrough and discharging the molten slag, an inner surface of the discharge chute being covered with castable at a location where the water-cooling jacket is provided.

With the above arrangement, since the portion where the water-cooling jacket 18 is located is covered with castable 20, even if the structural material for forming the water-cooling jacket 18 is made of inexpensive iron material, the iron material has a sufficient durability to corrosion. Preferably, the castable may be selected from various refractories (described later), for example, the castable for the water-cooling jacket 18 may contain silicon carbide, which has less fire resistance (refractoriness) than castable containing chromium but has a required corrosion resistance. When a chamber for containing therein the molten slag g in the slagging combustion furnace 7 has an inner wall of chromium-base castable or the like containing chromium of 5 % or more, and alumina as the rest, the chamber has a fire resistance of about 1300°C or higher and a sufficient corrosion resistance. Further, when the castable comprises a chamotte castable, the heat insulating properties can be improved.

According to a fourth aspect of the present invention, there is provided a gasification and slagging combustion system, comprising: a gasification furnace for gasifying wastes to produce combustible gas; and a slagging combustion furnace for combusting the combustible gas and melting ash content contained in the combustible gas. The wastes are pyrolyzed and gasified in a fluidized-bed 5 which is maintained at a relatively low temperature of 450 to 650°C,

for example. The combustible gas and char produced in a gasification furnace are combusted at a high temperature of 1300 to 1500°C, for example.

In order to achieve the above third object, there is provided a swirling-type slagging combustion furnace comprising: a combustion chamber for combusting combustible gas and melting ash content contained in the combustible gas; a slag discharge port provided at a bottom portion of the combustion chamber for discharging molten slag; a cooling device for cooling and solidifying the discharged molten slag; a slag discharge path interconnecting the slag discharge port and the cooling device for introducing the discharged molten slag downwardly; and a gas suction device for drawing gas produced by combustion of the combustible gas from the slag discharge path.

With the above arrangement, since a swirling-type slagging combustion furnace comprises a slag discharge path 204 and a gas suction device 215, a gas m is drawn by the gas suction device 215 to produce a flow of the gas m having a high temperature which flows from a slag discharge port 206 provided at a bottom portion of combustion chambers 201a, 201b, 201d through the slag discharge path 204 into the gas suction device 215. Therefore, a cold gas produced in the cooling device 205 is prevented from ascending in the slag discharge path 204 and hence does not reach the slag discharge port 206. As a result, the portion in the vicinity of the slag discharge port 206 can be maintained at a high temperature, and hence the temperature of the portion in the vicinity of the slag discharge port 206 is prevented from being lowered to not more than a slag melting temperature.

According to a preferred aspect of the present invention, the gas suction device has a suction port for drawing the produced gas, the temperature of the produced gas at the

suction port being increased to 100°C or more at the suction port.

With the above arrangement, since the temperature of the produced gas at the suction port is at least 100°C, water is not condensed in a passage for the gas m up to the suction port 215a. Therefore, dust contained in the gas m is prevented from being attached to the condensed portion of the suction pipe 213 and hence from clogging the passage for the gas m up to the suction port 215a.

According to a preferred aspect of the present invention, the gas suction device has a suction port for drawing the produced gas, the suction port being positioned above the cooling device.

According to a preferred aspect of the present invention, the swirling-type slagging combustion furnace further comprises a dust collector disposed upstream of the suction device with respect to a flow of the produced gas which is drawn from the slag discharge path for removing dust in the produced gas.

With the above arrangement, since the dust collector 214 is disposed upstream of the suction device 215 with respect to a flow of the produced gas m which is drawn from the slag discharge path 204, dust contained in the gas m is removed from the gas by the dust collector 214, for thereby protecting the gas suction device 215.

According to a preferred aspect of the present invention, the cooling device comprises a water quenching trough which holds water therein. With this arrangement, since the cooling device 205 comprises a water quenching trough 205 which holds water w therein, the discharged slag can rapidly be quenched by the water w in the water quenching trough 205.

According to a preferred aspect of the present invention, a lower portion of the slag discharge path is sealed

by the water.

The above and other objects, features, and advantages of the present invention will be apparent from the following description when taken in conjunction with the accompanying drawings which illustrates preferred embodiments of the present invention by way of example.

Brief Description of Drawings

FIG. 1 is a schematic view showing a gasification and slagging combustion system which is a combination of a fluidized-bed gasification furnace and a swirling-type slagging combustion furnace according to a first embodiment of the present invention;

FIG. 2 is a schematic view showing a structure for cooling and discharging molten slag in the gasification and slagging combustion system shown in FIG. 1;

FIGS. 3A through 3D are schematic views showing a structure for introducing molten slag into a slag discharge port;

FIG. 4 is a block diagram showing a swirling-type slagging combustion furnace according to a second embodiment of the present invention and a fluidized-bed gasification furnace which is disposed upstream of the swirling-type slagging combustion furnace;

FIG. 5 is a perspective view showing a portion in the vicinity of a slag discharge port of a slagging combustion furnace in a gasification and slagging combustion system which is a combination of a fluidized-bed gasification furnace and a swirling-type slagging combustion furnace;

FIG. 6 is a schematic cross-sectional view showing a portion in the vicinity of the slag discharge port of the slagging combustion furnace; and

FIG. 7 is a schematic view showing aggregated molten

slag formed on an inner wall of a discharge chute.

Best Mode for Carrying Out the Invention

A gasification and slagging combustion system including a slagging combustion furnace according to a first embodiment of the present invention will be described below with reference to FIGS. 1, 2, and 3A through 3D. Like or corresponding parts are denoted by like or corresponding reference numerals throughout drawings, and will not be described below repetitively.

FIG. 1 is a schematic view showing a gasification and slagging combustion system which is a combination of a fluidized-bed gasification furnace and a swirling-type slagging combustion furnace according to the first embodiment of the present invention. As shown in FIG. 1, the gasification and slagging combustion system (gasification and combustion fusion system) comprises a fluidized-bed gasification furnace 2 and a swirling-type slagging combustion furnace 7 (swirling-type combustion fusion furnace). Wastes a to be treated include at least one of municipal wastes, refuse-derived fuel, solid-water mixtures, plastic wastes, waste fiber-reinforced plastics (waste FRP), biomass wastes, automobile wastes, paper sludges, medical wastes, waste oil, and the like. Pre-treatment processes including crushing, screening, dewatering, and drying are performed on the wastes a to be treated, as needed. Then, the wastes a are supplied into the fluidized-bed gasification furnace 2 at a constant rate by a waste supply device (feed device) 1. The fluidized-bed gasification furnace 2 has a fluidizing gas supply chamber 3 disposed at the lower portion thereof. A fluidizing gas b is supplied to the fluidizing gas supply chamber 3 and ejected upwardly from a diffusion plate 4 into the fluidized-bed gasification furnace 2 to thus form a

fluidized-bed 5 of sand over the diffusion plate 4. The fluidizing gas b contains the amount of oxygen less than the amount of oxygen required for complete combustion of combustible components supplied into the fluidized-bed gasification furnace 2. The ratio of the amount of oxygen contained in the fluidizing gas b to the amount of oxygen required for theoretical complete combustion is in the range of 0.1 to 0.9, preferably 0.1 to 0.3. When the fluidizing gas is supplied to one region at a relatively higher flow rate and to another region at a relatively lower flow rate, a fluidized medium ascends in the region to which the fluidizing gas is supplied at a higher flow rate and descends in the region to which the fluidizing gas is supplied at a lower flow rate, for thereby forming a circulating flow in the fluidized-bed 5. Specifically, by forming a circulating flow in the fluidized-bed 5, gasification of wastes can be slowly carried out, and hence a gas can stably be supplied to the slagging combustion furnace. A circulating flow may be formed by an external circulating fluidized-bed furnace. Therefore, it is more preferable to supply the fluidizing gas to one region at a relatively higher flow rate and to another region at a relatively lower flow rate in the fluidized-bed gasification furnace 2.

The wastes a are introduced from the waste supply device 1 into the fluidized-bed 5 which is maintained at a temperature ranging from 450 to 650°C. Preferably, the wastes a should be supplied into the fluidized-bed 5 at a constant rate in order to stabilize the amount and quality of the gas to be introduced into the subsequent slagging combustion furnace. Then, the introduced wastes a are pyrolyzed and gasified in the fluidized-bed 5. In the case of the fluidized-bed gasification furnace in which a circulating flow is formed as described above, while being drawn into the

descending fluidized-bed, the wastes are pyrolyzed and gasified in the fluidized-bed 5 to produce combustible gas, tar, and char. The char is gradually pulverized in the fluidized-bed 5 by a stirring motion of the fluidized-bed 5 and combustion reaction with oxygen. Incombustibles h are discharged together with sand (fluidized medium) from the bottom of the fluidized-bed gasification furnace 2. Since the interior of the fluidized-bed 5 is in a reducing atmosphere, metals contained in the incombustibles h are recovered as an ingot which is in a non-oxidized condition and from which attached components are removed. Such an ingot is suitable for recycling use. The incombustibles h and the sand which are discharged from the gasification furnace 2 are mechanically classified from each other, and only the sand is returned to the gasification furnace 2. Secondary air c is blown into a freeboard 6 of the fluidized-bed gasification furnace 2 to oxidize and combust the char deposited on or accumulated in the fluidized-bed 5.

The produced gas d accompanied with the pulverized char, which flows into the atmosphere upwards of the fluidized-bed after pulverization, is supplied from the gasification furnace 2 through a duct communicating with the swirling-type slagging combustion furnace 7 into a primary combustion chamber 8 in the swirling-type slagging combustion furnace 7. The produced gas d including char is mixed in a swirling flow with air e supplied from the side walls of the primary combustion chamber 8 and rapidly combusted at a high temperature ranging from 1300 to 1400°C. By combustion at a high temperature, inorganic matter (ash content) contained in the char is converted into slag mist. The slag mist is mostly collided with the inner walls of the primary combustion chamber 8 and a secondary combustion chamber 9 due to the centrifugal forces of the swirling flow to form molten slag phase in the

combustion chambers 8, 9. The molten slag is trapped on the inner walls of the combustion chambers 8, 9, flows downwardly thereon due to gravity, and is then discharged from a slag discharge port 11 provided at a bottom portion of the secondary combustion chamber 9. Then, the molten slag falls down through a space defined in a discharge chute 14 into water in a water quenching trough 15, and rapidly quenched by the water in the water quenching trough 15. Unburned combustibles remaining in the produced gas are combusted at a temperature ranging from 900 to 1400°C in a tertiary combustion chamber 10 into which air e is additionally supplied. An exhaust gas f is discharged from the upper end of the tertiary combustion chamber 10. The exhaust gas f is passed through a series of heat recovery equipment or dust removing equipment (not shown), and then discharged to the atmosphere.

The gasification and slagging combustion system described above has the following advantageous features.

(1) Combustion at a high temperature ranging from 1300 to 1400°C in a swirling-type slagging combustion furnace can suppress synthesis of dioxins or furan.

(2) Inorganic matter contained in wastes is converted into slag mist in a swirling-type slagging combustion furnace, and the slag mist is highly efficiently converted into molten slag due to centrifugal forces of a swirling flow and the wet wall effect in which slag mist is mostly trapped by molten slag phase on an inner wall of a combustion chamber and flows downwardly on the inner wall of the combustion chamber. Formation of water-cooled slag by cooling molten slag in water can reduce the mass of the slag and improve the stability of the slag. Thus, the life of landfill sites can be prolonged, and the slag can be utilized as materials for civil engineering construction.

FIG. 2 is a schematic view showing a structure for

cooling and discharging molten slag in the gasification and slagging combustion system shown in FIG. 1. As shown in FIG. 2, the primary combustion chamber 8 has a burner 12 provided at the upper end thereof for temperature rising, and a burner 13 provided at a lower end which communicates with the secondary combustion chamber 9 for temperature rising. The water quenching trough 15 has such a structure that water flows on a slide. The molten slag falls down from the slag discharge port 11 provided at the bottom portion of the swirling-type slagging combustion furnace 7 through the space in the discharge chute 14 into water in the water quenching trough 15, and rapidly quenched by the water in the water quenching trough 15. Thus, the molten slag is converted into granulated slag g'. Then, the granulated slag g' is delivered together with the water onto a slag conveyor 16, which continuously conveys the granulated slag g' to the exterior. The temperature of the interior of the discharge chute 14 is in the range of about 700°C to about 900°C.

As shown in FIG. 2, the secondary combustion chamber 9 has the bottom portion 91 extending from a portion connected to the primary combustion chamber 8 to the slag discharge port 11. The bottom portion 91 is inclined at a gentle angle ranging from 10 to 20 degrees. A water-cooling jacket 18 is provided in the discharge chute 14 as a portion of the discharge chute 14. The water-cooling jacket 18 has an outer wall 183, an inner wall 184, a cooling water supply port 181 provided at an upper portion of the outer wall 183, and a cooling water discharge port 182 provided at an lower portion of the outer wall 183. The discharge chute 14 has a castable 20 for covering the inner wall 184 of the water-cooling jacket 18. The castable 20 may be selected in consideration of which of cost, environmental condition in the slagging combustion furnace (gas temperature and gas components in the furnace), impact

resistance, corrosion resistance, and heat resistance is important.

As a preferable refractory to be used, $MgO \cdot Cr_2O_3$ refractory, $MgO \cdot Al_2O_3$ refractory, and $SiO_2 \cdot Al_2O_3$ refractory are enumerated. Further, ZrO_2, Fe_2O_3, Y_2O_3, CaO, TiO_2 or the like as a raw material may be added to the above refractory, and mixed together to produce refractory. These refractories may be used as castable or brick. For example, roseki fire, mullite refractory, sillimanite refractory may be used. The mullite refractory comprises high alumina refractory containing $3Al_2O_3 \cdot 2SiO_2$ as a main component, is dense, and is durable to rapid heating and rapid cooling. Alumina-silica refractory is composed mainly of alumina and silica, and has a high heat resistance. These refractories are also used as castable or brick.

The castable may be a mixture of fire-resistant crushed stones containing silicon carbide (SiC) and a binder such as hydraulic cement containing alumina. Since the inner wall 184 of the water-cooling jacket 18 is covered with the castable 20, the water-cooling jacket 18 has a sufficient durability even if the inner wall 184 is made of a material, such as sheet iron, having a relatively lower corrosion resistance to a corrosive gas than stainless steel sheet and nickel steel sheet.

Even if aggregated slag 17 (see FIG. 7) is formed on the inner wall 184 of the water-cooling jacket 18 or the castable 20, a portion of the inner wall 184 or the castable 20 to which the aggregated slag 17 is attached is forcibly cooled by the water-cooling jacket 18. Therefore, a portion of the aggregated slag 17 which attaches to the inner wall 184 or the castable 20 becomes fragile amorphism, and hence the aggregated slag 17 can be dropped due to its gravity when it is small in size.

FIGS. 3A through 3D are schematic views showing a structure for introducing the molten slag into the slag discharge port. FIG. 3A is a front cross-sectional view showing the bottom portion 91 of the secondary combustion chamber 9 and the water-cooling jacket 18, FIG. 3B is a plan view as viewed along a direction indicated by the arrows B in FIG. 3A, FIG. 3C is a cross-sectional view taken along a line C-C of FIG. 3A, and FIG. 3D is a perspective view as viewed along a direction indicated by the arrows D in FIG. 3A. As shown in FIG. 3B, the bottom portion 91 of the secondary combustion chamber 9 has an introducing groove 93 defined in the upper surface thereof for introducing the molten slag from the upstream to the slag discharge port 11.

As shown in FIG. 3C, the introducing groove 93 has a lower surface 93a having a width of W_0 and an upper surface 93b having a width of W_1 to form a concave two-stage groove. This arrangement allows the molten slag to flow at a sufficient flow velocity even if the molten slag has a low flow rate, and prevents the molten slag from overflowing the introducing groove 93 even if the molten slag has a high flow rate. As shown in FIG. 3D, the introducing groove 93 has a length of L, and has a wider width of W_3 at the upstream side and a narrower width of W_2 at the side of the slag discharge port 11. Thus, the introducing groove 93 has a passage which is reduced in width gradually from the upstream side of the bottom portion 91 toward the slag discharge port 11. This arrangement allows the molten slag to be introduced into the slag discharge port 11 at a sufficiently high flow velocity so that the falling molten slag reliably reaches the water quenching trough 15.

As shown in FIG. 3B, the slag discharge port 11 has a plate 112 and a hole (window) 111 defined in the plate 112 for allowing the molten slag flowing downwardly on the introducing groove 93, the bottom portion 91, side walls 92

of the secondary combustion chamber 9, and an inner wall 101 of the tertiary combustion chamber 10 to fall down onto the water quenching trough 15 through the discharge chute 14. The hole 111 has a circular shape or an elliptical shape. The hole 111 may have a polygonal shape, a substantially rectangular shape, or a substantially trigonous shape as long as it has corners which are formed into round. When the amount of slag is considered to be large, an auxiliary introducing groove may be provided in the side walls 92 of the secondary combustion chamber 9 and/or the inner wall 101 of the tertiary combustion chamber 10. The plate 112 has a smooth shape for preventing the molten slag flowing downwardly on the introducing groove 93, the bottom portion 91, the side walls of the secondary combustion chamber 9, and the inner wall 101 of the tertiary combustion chamber 10 from losing its fluidity to accumulate as solid slag on the way. The plate 112 has four corners which are formed into round. Further, by making the hole 111 defined in the plate 112 relatively small, water vapor produced when the molten slag is rapidly quenched in the water quenching trough 15 is prevented from ascending in the discharge chute 14 so as not to lower the temperature of the vicinity of the molten slag discharge port 11.

The swirling-type slagging combustion furnace 7 has the combustion chambers 8, 9, 10 for containing the molten slag therein. The combustion chambers 8, 9, 10 have inner walls of castables of chromium. Specifically, as shown in FIG. 3A, the inner walls of the secondary combustion chamber 9 and the tertiary combustion chamber 10 are covered with castables 22, 23. The castables 20, 22, 23 may be selected in consideration of which of cost, environmental condition in the slagging combustion furnace (gas temperature and gas components in the furnace), impact resistance, corrosion resistance, and heat resistance is important.

As a preferable refractory to be used, $MgO \cdot Cr_2O_3$ refractory, $MgO \cdot Al_2O_3$ refractory, and $SiO_2 \cdot Al_2O_3$ refractory are enumerated. Further, ZrO_2, Fe_2O_3, Y_2O_3, CaO, TiO_2 or the like as a raw material may be added to the above refractory, and mixed together to produce refractory. These refractories may be used as castable or brick. For example, roseki fire, mullite refractory, sillimanite refractory may be used. The mullite refractory comprises high alumina refractory containing $3Al_2O_3 \cdot 2SiO_2$ as a main component, is dense, and is durable to rapid heating and rapid cooling. Alumina-silica refractory is composed mainly of alumina and silica, and has a high heat resistance. These refractories are also used as castable or brick.

The castable may contain chromium oxide of 10 % or more by weight of chromium. The environmental temperature which is the temperature of the atmosphere around the castable 23 of the tertiary combustion chamber 10 is lower than the environmental temperature which is the temperature of the atmosphere around the castable 22 of the secondary combustion chamber 9. Further, combustion reaction is mostly completed in the secondary combustion chamber 9. Therefore, even when the castable 23 of the tertiary combustion chamber 10 contains chromium oxide of 5 % or more by weight of chromium, it has a sufficient durability. However, when a castable which contains chromium oxide of 3 % or less by weight of chromium was used as the castable 23 of the tertiary combustion chamber 10, it did not have a required corrosion resistance. When a castable which contains chromium oxide of 0 % by weight of chromium, i.e., which contains only alumina, was used as the castable 23 of the tertiary combustion chamber 10, it did not have a required corrosion resistance as well.

As with the castable 23 of the tertiary combustion chamber 10, when the castable 20 of the water-cooling jacket

18 contains chromium oxide of 5 % or more by weight of chromium, it has a sufficient durability. The environmental temperature around the discharge chute 14 is lower than the environmental temperature around the tertiary combustion chamber 10 which is about 1300°C, and is about 1100°C or lower. Further, the activity of a reactive gas is low around the discharge chute 14. Therefore, the castable 20 of the water-cooling jacket 18 may contain chromium oxide of 5 % or more by weight of chromium. Alternatively, the castable 20 of the water-cooling jacket 18 may contain silicon carbide (SiC) which has a fire resistance (refractriness) of about 1100°C or lower.

In the embodiment described above, the introducing groove comprises a concave two-stage groove. However, the introducing groove may have any shapes as long as the molten slag is introduced into the slag discharge port 11 at a sufficiently high flow velocity so that the flowing molten slag reliably reaches the water quenching trough 15. In the above embodiment, the plate 112 of the slag discharge port 11 has round corners. However, the plate 112 may have such a structure that by using materials having a good wettability for the molten slag, the molten slag is prevented from stagnating on the plate 112.

According to the present invention, in a slagging combustion furnace having an introducing groove for gathering molten slag, a castable which contains chromium oxide of 5 % or more by weight of chromium is used as a material for the introducing groove. Even if loads, such as heat of the slag, corrosion or corrosive damage caused by molten salts contained in the slag, are intensively imposed on the introducing groove, the slagging combustion furnace can employ an introducing groove structure having a sufficient durability from the viewpoints of life and maintenance of the furnace. Thus, it would be apparent to those skilled in the art that many

modifications and variations may be made therein without departing from the spirit and scope of the present invention.

As described above, according to the present invention, a slagging combustion furnace comprises a combustion chamber for combusting a gas produced in a gasification furnace at a high temperature; a slag discharge port provided at a bottom portion of the combustion chamber for discharging molten slag produced by combustion at a high temperature; and an introducing groove provided at the bottom portion of the combustion chamber for introducing the molten slag flowing downwardly on the bottom portion into the slag discharge port. This introducing groove has a passage which is reduced in width gradually from the upstream side of the bottom portion toward the slag discharge port. Therefore, the molten slag is prevented from being solidified in the vicinity of the molten slag discharge port so as not to clog a discharge chute with the molten slag. The present invention is effective in the case where the amount of ash content contained in gas and char supplied from a gasification furnace is large.

According to the present invention, a slagging combustion furnace comprises a combustion chamber for combusting a gas produced in a gasification furnace at a high temperature; and a slag discharge port provided at a bottom portion of the combustion chamber for discharging molten slag produced by combustion at a high temperature. This slag discharge port has a smooth shape for preventing the molten slag from stagnating thereon. Therefore, the molten slag is prevented from being solidified in the vicinity of the molten slag discharge port so as not to clog a discharge chute with the molten slag. As a result, the molten slag can continuously and stably be discharged from the molten slag discharge port and can be cooled in water to form water-cooled slag. Thus, the gasification and slagging combustion system can

continuously be operated for a long time.

According to the present invention, a slagging combustion furnace comprises a combustion chamber for combusting a gas produced in a gasification furnace at a high temperature; a slag discharge port provided at a bottom portion of the combustion chamber for discharging molten slag produced by combustion at a high temperature; and a discharge chute having a water-cooling jacket for allowing the molten slag to pass therethrough and discharging the molten slag. This water-cooling jacket is covered with a castable. Even if the water-cooling jacket is made of a material, such as sheet iron, having a relatively lower corrosion resistance to a corrosive gas than stainless steel sheet and nickel steel sheet, the castable can enhance the corrosion resistance of the water-cooling jacket. Therefore, the life of the slagging combustion furnace can be lengthened with an inexpensive material.

A swirling-type slagging combustion furnace according to a second embodiment of the present invention will be described below with reference to FIG. 4.

FIG. 4 is a block diagram showing a structure of a swirling-type slagging combustion furnace (swirling-type combustion fusion furnace) 201 according to the second embodiment of the present invention and a fluidized-bed gasification furnace 231. The swirling-type slagging combustion furnace 201 is connected to and disposed downstream of the fluidized-bed gasification furnace 231. The swirling-type slagging combustion furnace 201 comprises a vertically extending primary combustion chamber 201a, a secondary combustion chamber 201b connected to a lower end of the primary combustion chamber 201a and inclined downwardly therefrom, a vertically extending tertiary combustion chamber 201d connected to a lower end of the secondary combustion

chamber 201b, a slag separation section 201c disposed at a bottom portion of the tertiary combustion chamber 201d and serving as a bottom portion of the furnace, an inlet port 202 at an upper end portion of the primary combustion chamber 201a, and an outlet port 203 at an upper end portion of the tertiary combustion chamber 201d. The slag separation section 201c has a slag discharge port 206 for discharging slag g in the form of molten ash. The swirling-type slagging combustion furnace 201 also has a slag discharge duct (slag discharge path) 204 connected to the slag discharge port 206 and extending downwardly therefrom, a water quenching trough (cooling device) 205 connected to a lower end of the slag discharge duct 204, a suction blower (gas suction device) 215, and a dust collector 214.

The water quenching trough 205 has a slope 208, a water reservoir 209 for storing water w having a temperature ranging from 90°C to 100°C, a slag conveyor 210 for delivering the slag g which has been solidified in the water reservoir 209, and a water circulating device 216. The lower end of the slag discharge duct 204 and the water reservoir 209 are connected to each other by a slope 208. When the molten slag g is brought into contact with the water, water is evaporated into water vapor as a cold gas. Water is constantly supplied to the water reservoir 209 by amount corresponding to the amount of water which has been evaporated. The water circulating device 216 has a water circulation pipe 219 interconnecting a water inlet 217 and a supply port 218, and a water circulating pump 220 connected to the water circulation pipe 219 for circulating the water w. The water inlet 217 is defined in the water reservoir 209, and the supply port 218 is defined in the uppermost portion of the slope 208.

The slag discharge duct 204 has a suction port 211 defined in a lower portion thereof for drawing a produced gas

m flowing through the slag discharge duct 204. The tertiary combustion chamber 201d has a discharge port 212 for discharging the produced gas m drawn from the suction port 211 into the tertiary combustion chamber 201d. The suction port 211 and the discharge port 212 are interconnected by a suction pipe 213. The suction pipe 213 has a dust collector 214 provided thereon for removing dust in the produced gas m, and the suction blower 215 provided thereon for drawing and discharging the produced gas m. Specifically, the dust collector 214 is disposed upstream of the suction blower 215 with respect to the flow of the produced gas m which is drawn from the slag discharge duct 204. The suction blower 215 has a suction port 215a connected to the dust collector 214. The dust collector 214 may comprise a dry-type inertial dust collector, but should preferably comprise a wet-type scrubber when the produced gas m contains a large amount of dust.

Operation of the swirling-type slagging combustion furnace 201 thus constructed will be described below.

Wastes a are supplied into the fluidized-bed gasification furnace 231, and combustion air h is introduced into the fluidized-bed gasification furnace 231 from the bottom of the furnace to form a fluidized-bed over an air diffusing plate 232 disposed in the fluidized-bed gasification furnace 231. The supplied wastes a are gasified at a low temperature ranging from 450°C to 650°C to produce a gas m.

The produced gas m is introduced from the fluidized-bed gasification furnace 231 into the primary combustion chamber 201a through the inlet port 202 defined in the upper end portion of the swirling-type slagging combustion furnace 201. The produced gas m is accompanied with solid carbon pulverized by the fluidized-bed. The combustion air h which has been preheated is introduced into the primary combustion chamber 201a from the upper end portion thereof.

In the primary combustion chamber 201a, the produced gas m is mixed with the combustion air h to form a swirling flow. The produced gas m is combusted at a high temperature ranging from 1200 to 1500°C, and flows downwardly.

The ash content contained in the solid carbon is entirely converted into slag mist due to a high temperature. The slag mist is mostly trapped by molten slag phase on an inner wall of the primary combustion chamber 201a under centrifugal forces of the swirling flow. The molten slag flows downwardly on the inner wall of the primary combustion chamber 201a and enters the secondary combustion chamber 201b. Then, the molten slag is discharged from the slag discharge port 206 in the slag separation section 201c into the slag discharge duct 204. Unburned combustibles remaining in the produced gas m is completely combusted in the tertiary combustion chamber 201d by the combustion air h supplied from a lower portion of the tertiary combustion chamber 201d.

The molten slag discharged from the slag discharge port 206 passes through the slag discharge duct 204, flows downwardly on the slope 208 of the water quenching trough 205 into the water reservoir 209, and is cooled and solidified by the water w which flows down the slope 208 and the water w which is held in the water reservoir 209. The slag g solidified in the water reservoir 209 is delivered from the water reservoir 209 by the slag conveyor 210.

The water w held in the water reservoir 209 is drawn from the water inlet 217 of the water reservoir 209 by the water circulating pump 220, and flows through the water circulation pipe 219. Then, the water w is discharged from the supply port 218 defined in the uppermost portion of the slope 208, and flows downwardly on the slope 208 back into the water reservoir 209. In this manner, the water w in the water reservoir 209 is circulated. The molten slag g flowing through the slag

discharge duct 204 falls onto the slope 208 and is cooled by the water w flowing downwardly on the slope 208. The molten slag g further flows downwardly on the slope 208 into the water reservoir 209. Therefore, the molten slag g is not deposited on the slope 208, but reliably flows downwardly and is collected in the water reservoir 209. When the molten slag g falls onto the slope 208 and is brought into contact with the water w, water vapor s is produced and ascends in the slag discharge duct 204.

The produced gas m in the slag discharge duct 204 is drawn from the suction port 211 of the slag discharge duct 204 together with the water vapor s ascending in the slag discharge duct 204 by the suction blower 215. The produced gas m and the water vapor s which have thus been drawn by the suction blower 215 pass through the suction pipe 213, and are discharged from the discharge port 212 into the tertiary combustion chamber 201d. A lower portion of the slag discharge duct 204, i.e., a lower portion of the slope 208 in the present embodiment, is sealed by the water w. Consequently, this causes a flow of the produced gas m which passes from the slag discharge port 206 through the slag discharge duct 204. This flow of the produced gas m originates from a portion of the flow of the produced gas m directed from the secondary combustion chamber 201b to the tertiary combustion chamber 201d, and is branched by the slag separation section 201c as a flow passing from the slag discharge port 206 through the slag discharge duct 204.

The high-temperature produced gas m flows into an upper portion of the slag discharge duct 204, is drawn into the suction pipe 213, and is then discharged into the tertiary combustion chamber 201d. The suction port 211 is positioned above a region where the water vapor s is produced when the molten slag g is cooled, i.e., above the cooling device. Consequently, the water vapor s that is produced when the molten

slag g is discharged from the slag discharge port 206 through the slag discharge duct 204 and then brought into contact with the water w in the water quenching trough 205 and that ascends in the slag discharge duct 204 can easily be drawn into the suction port 211. Further, the water vapor s is prevented from ascending in the slag discharge duct 204 by the flow of the produced gas m that is drawn into the suction port 211. As a result, the water vapor s does not reach the slag discharge port 206. Therefore, the portion in the vicinity of the slag discharge port 206 can be maintained at a high temperature, and hence the portion in the vicinity of the slag discharge port 206 is prevented from being lowered in temperature. Particularly, since the lower portion of the slag discharge duct 204, i.e., the lower portion of the slope 208 in the present embodiment, is sealed by the water w in the water reservoir 209, it is possible to effectively produce the flow of the produced gas m passing from the slag discharge port 206 through the slag discharge duct 204.

The area of the opening of the slag discharge port 206, the distance of the suction port 211 from the slag discharge port 206, the distance of the suction port 211 from the slope 208, the size of the suction port 211, the size of the suction pipe 213, and the flow velocity in the suction pipe 213 may be selected as appropriate values to cause the produced gas m to have a temperature of at least 100°C at the suction port 215a of the suction blower 215, and a temperature of 350°C or lower at the suction port 215a of the suction blower 215 from the viewpoint of the temperatures that the dust collector 214 and the suction blower 215 can withstand, for example. Since the temperature of the produced gas m at the suction port 215a is at least 100°C, the evaporated water w is not condensed in the suction pipe 213 up to the suction port 215a. Therefore, dust is prevented from being attached to the inner surface of

the suction pipe 213 and hence from clogging the suction pipe 213.

While the suction port 211 comprises a single suction port defined in the slag discharge duct 204 in FIG. 4, it is desirable to define a plurality of ports positioned at angularly equal intervals in a horizontally circumferential direction of the slag discharge duct 204. A plurality of the suction ports 11 are more effective to prevent the temperature of the produced gas m from being lowered in the vicinity of the slag discharge port 206.

The liquid level of the water w flowing downwardly on the slope 208 should be spaced apart from the suction port 211 by a distance which is large enough to prevent water droplets splashed by the slag g falling down onto the slope 208 from being drawn into the suction port 211.

In the swirling-type slagging combustion furnace 201 according the present embodiment, the distance between the suction port 211 and the uppermost portion of the slope 208 should preferably be large enough to prevent the high-temperature produced gas m which is directed from the slag discharge port 206 toward the water quenching trough 205, flows downwardly through the slag discharge duct 204, and is drawn into the suction port 211, from reaching the water w flowing downwardly on the slope 208.

Although the swirling slagging combustion furnace 201 according the present embodiment has been described as having the water quenching trough 205 which has the slope 208, the water quenching trough may not have a slope, but may have a vertically straight shape at a portion which corresponds to the slope. Such a water quenching trough can minimize any effect on the water quenching trough due to changes of the ambient temperature.

As described above, according to the present

invention, since a swirling-type slagging combustion furnace comprises a slag discharge path and a gas suction device, a gas is drawn by the gas suction device to produce a flow of the gas having a high temperature which flows from a slag discharge port provided at a bottom portion of a combustion chamber through the slag discharge path into the gas suction device. Therefore, a cold gas produced in the cooling device is prevented from ascending in the slag discharge path and hence does not reach the slag discharge port. As a result, the slag discharge port can be maintained at a high temperature, and hence the temperature of the portion in the vicinity of the slag discharge port is prevented from being lowered to a melting temperature or less. Consequently, molten ash content can stably be discharged from the swirling-type slagging combustion furnace.

Although certain preferred embodiments of the present invention have been shown and described in detail, it should be understood that various changes and modifications may be made therein without departing from the scope of the appended claims.

Industrial Applicability

The present invention is applicable to a gasification and slagging combustion system for completely combusting wastes without generating dioxins by gasification and slagging combustion to melt ash content contained in the wastes into slag. The present invention is also applicable to a swirling-type slagging combustion furnace for combusting a gas produced by pyrolysis gasification of wastes such as municipal wastes at a low temperature in a gasification furnace, at a high temperature to melt ash content contained in the produced gas.

CLAIMS

1. A slagging combustion furnace comprising:

a combustion chamber for combusting combustible gas and melting ash content contained in said combustible gas;

a slag discharge port provided at a bottom portion of said combustion chamber for discharging molten slag produced by melting of said ash content; and

an introducing groove provided at said bottom portion of said combustion chamber for introducing said molten slag flowing downwardly on said bottom portion into said slag discharge port, said introducing groove having a passage which is reduced in width gradually from the upstream side of said bottom portion toward said slag discharge port.

2. A slagging combustion furnace according to claim 1, wherein said combustible gas is produced by gasification of material in a gasification furnace.

3. A slagging combustion furnace according to claim 1, further comprising a chamber containing therein said molten slag, said chamber having an inner wall of castable.

4. A slagging combustion furnace comprising:

a combustion chamber for combusting combustible gas and melting ash content contained in said combustible gas; and

a slag discharge port provided at a bottom portion of said combustion chamber for discharging molten slag produced by melting of said ash content, said slag discharge port having a smooth shape for preventing said molten slag from stagnating thereon.

5. A slagging combustion furnace according to claim 4, wherein said combustible gas is produced by gasification of material in a gasification furnace.

6. A slagging combustion furnace according to claim 4, wherein said smooth shape comprises at least one of a circular shape and an elliptical shape.

7. A slagging combustion furnace according to claim 4, further comprising a chamber containing therein said molten slag, said chamber having an inner wall of castable.

8. A slagging combustion furnace comprising:

a combustion chamber for combusting combustible gas and melting ash content contained in said combustible gas;

a slag discharge port provided at a bottom portion of said combustion chamber for discharging molten slag produced by melting of said ash content; and

a discharge chute having a water-cooling jacket for allowing said molten slag to pass therethrough and discharging said molten slag, an inner surface of said discharge chute being covered with castable at a location where said water-cooling jacket is provided.

9. A slagging combustion furnace according to claim 8, wherein said combustible gas is produced by gasification of material in a gasification furnace.

10. A slagging combustion furnace according to claim 8, wherein said castable contains silicon carbide.

11. A slagging combustion furnace according to claim 8, further comprising a chamber containing therein said molten slag, said chamber having an inner wall of castable.

12. A gasification and slagging combustion system, comprising:

a gasification furnace for gasifying wastes to produce combustible gas; and

a slagging combustion furnace for combusting said combustible gas and melting ash content contained in said combustible gas;

said slagging combustion furnace comprising:

a combustion chamber for combusting said combustible gas and melting ash content contained in said combustible gas;

a slag discharge port provided at a bottom portion of said combustion chamber for discharging molten slag produced by melting of said ash content; and

an introducing groove provided at said bottom portion of said combustion chamber for introducing said molten slag flowing downwardly on said bottom portion into said slag discharge port, said introducing groove having a passage which is reduced in width gradually from the upstream side of said bottom portion toward said slag discharge port.

13. A gasification and slagging combustion system according to claim 12, further comprising a chamber containing therein said molten slag, said chamber having an inner wall of castable.

14. A gasification and slagging combustion system, comprising:

a gasification furnace for gasifying wastes to produce combustible gas; and

a slagging combustion furnace for combusting said combustible gas and melting ash content contained in said combustible gas;

said slagging combustion furnace comprising:

a combustion chamber for combusting said combustible gas and melting ash content contained in said combustible gas; and

a slag discharge port provided at a bottom portion of said combustion chamber for discharging molten slag produced by melting of said ash content, said slag discharge port having a smooth shape for preventing said molten slag from stagnating thereon.

15. A gasification and slagging combustion system according to claim 14, wherein said smooth shape comprises at least one of a circular shape and an elliptical shape.

16. A gasification and slagging combustion system according to claim 14, further comprising a chamber containing therein said molten slag, said chamber having an inner wall of castable.

17. A gasification and slagging combustion system, comprising:

a gasification furnace for gasifying wastes to produce combustible gas; and

a slagging combustion furnace for combusting said combustible gas and melting ash content contained in said combustible gas;

said slagging combustion furnace comprising:

a combustion chamber for combusting said combustible gas and melting ash content contained in said combustible gas;

a slag discharge port provided at a bottom portion of said combustion chamber for discharging molten slag produced by melting of said ash content; and

a discharge chute having a water-cooling jacket for allowing said molten slag to pass therethrough and discharging said molten slag, an inner surface of said discharge chute being covered with castable at a location where said water-cooling jacket is provided.

18. A gasification and slagging combustion system according to claim 17, wherein said castable contains silicon carbide.

19. A gasification and slagging combustion system according to claim 17, further comprising a chamber containing therein said molten slag, said chamber having an inner wall of castable.

20. A swirling-type slagging combustion furnace comprising:

a combustion chamber for combusting combustible gas and melting ash content contained in said combustible gas;

a slag discharge port provided at a bottom portion of said combustion chamber for discharging molten slag;

a cooling device for cooling and solidifying said discharged molten slag;

a slag discharge path interconnecting said slag discharge port and said cooling device for introducing said discharged molten slag downwardly; and

a gas suction device for drawing gas produced by combustion of said combustible gas from said slag discharge path.

21. A swirling-type slagging combustion furnace according to claim 20, wherein said combustible gas is produced by gasification of material in a gasification furnace.

22. A swirling-type slagging combustion furnace according to claim 20, wherein said gas suction device has a suction port for drawing said produced gas, the temperature of said produced gas at said suction port being increased to 100°C or more at said suction port.

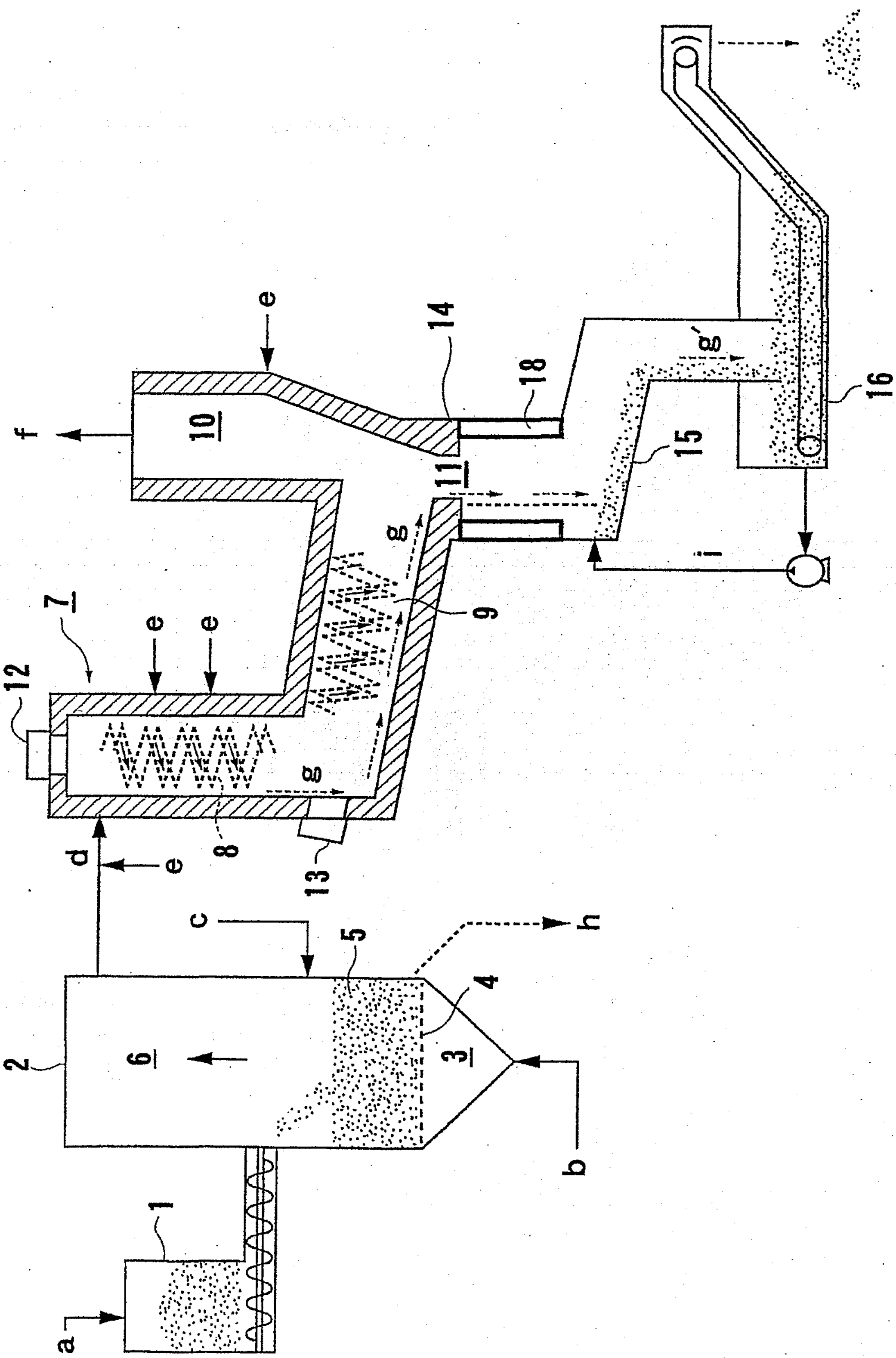
23. A swirling-type slagging combustion furnace according to claim 20, wherein said gas suction device has a suction port for drawing said produced gas, said suction port being positioned above said cooling device.

24. A swirling-type slagging combustion furnace according to claim 20, further comprising a dust collector disposed upstream of said suction device with respect to a flow of said produced gas which is drawn from said slag discharge path for removing dust in said produced gas.

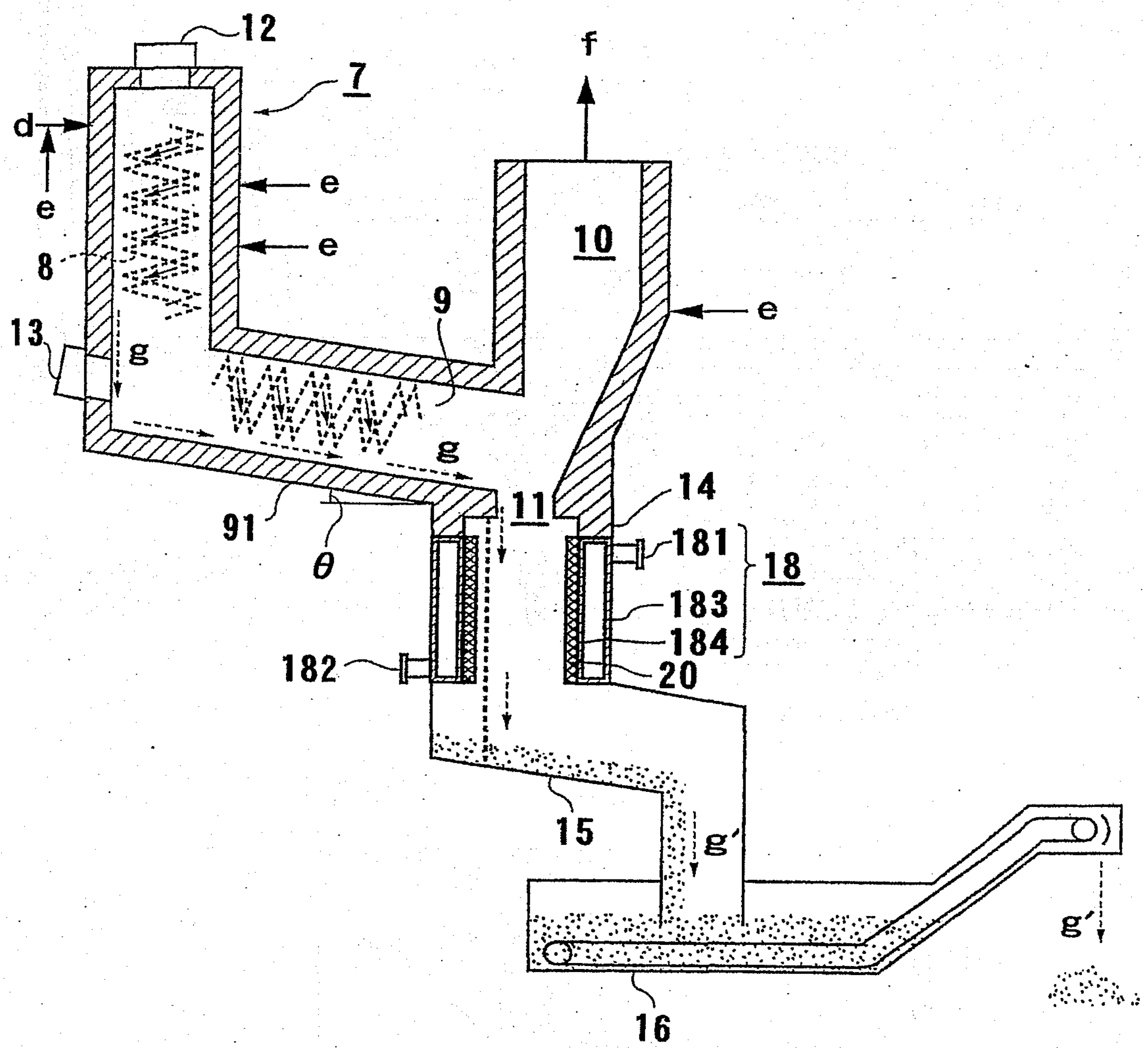
25. A swirling-type slagging combustion furnace according to claim 20, wherein said cooling device comprises a water quenching trough which holds water therein.

26. A swirling-type slagging combustion furnace according to claim 25, wherein a lower portion of said slag discharge path is sealed by said water.

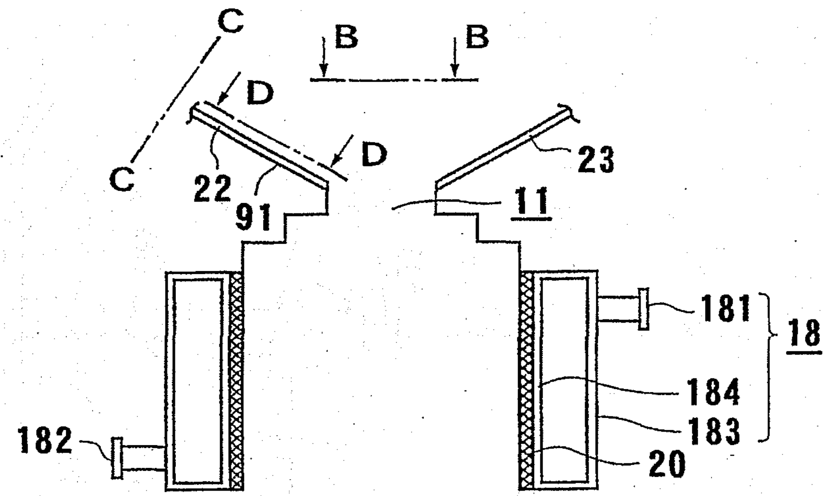
F I G. 1



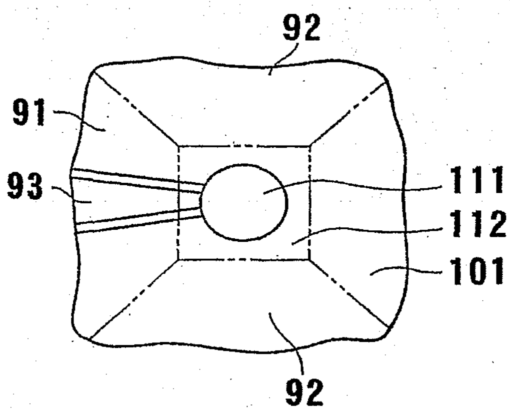
F I G. 2



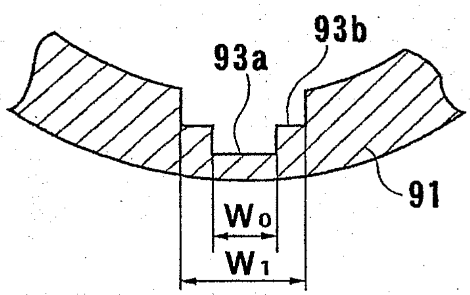
F I G. 3 A



F I G. 3 B



F I G. 3 C



F I G. 3 D

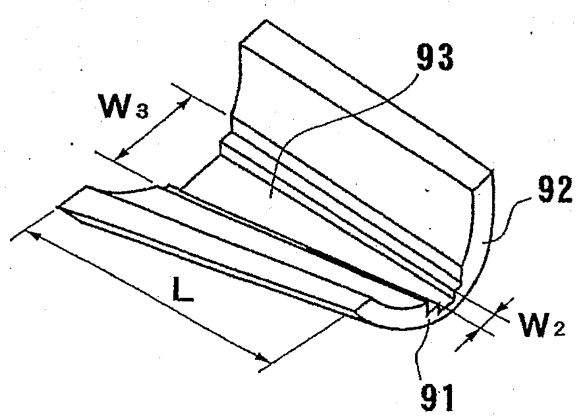


FIG. 4

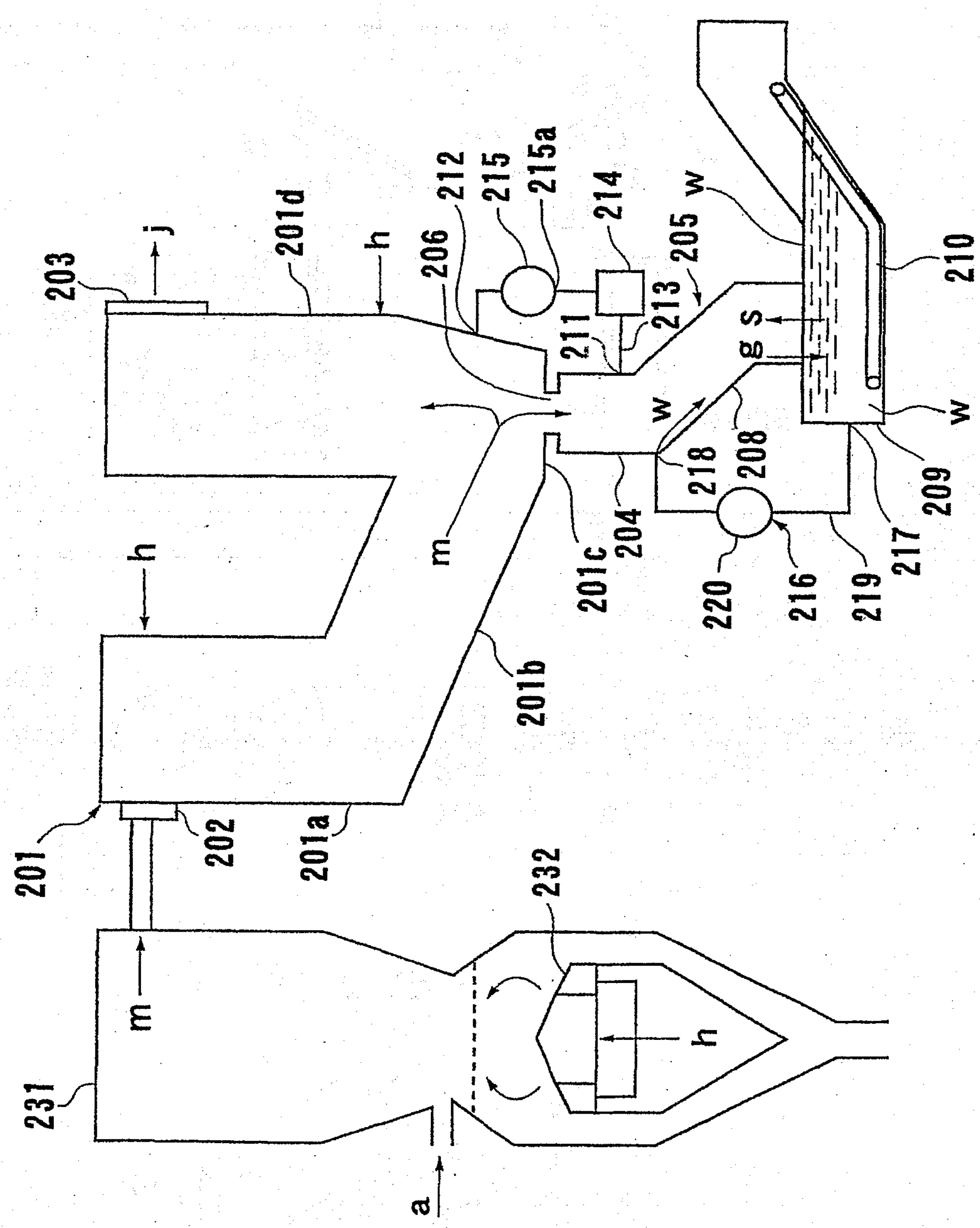

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FIG. 5

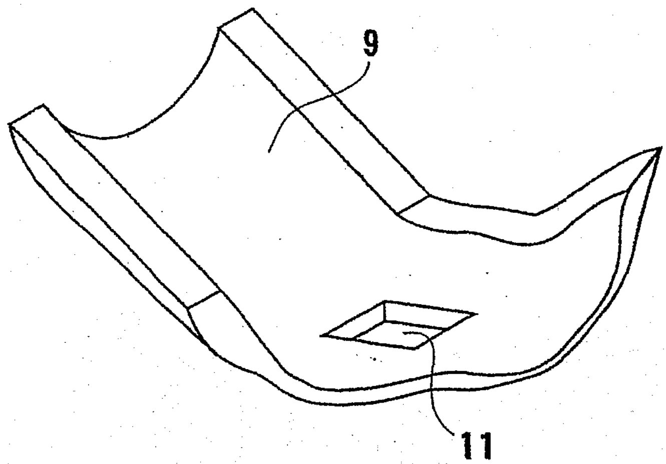


FIG. 6

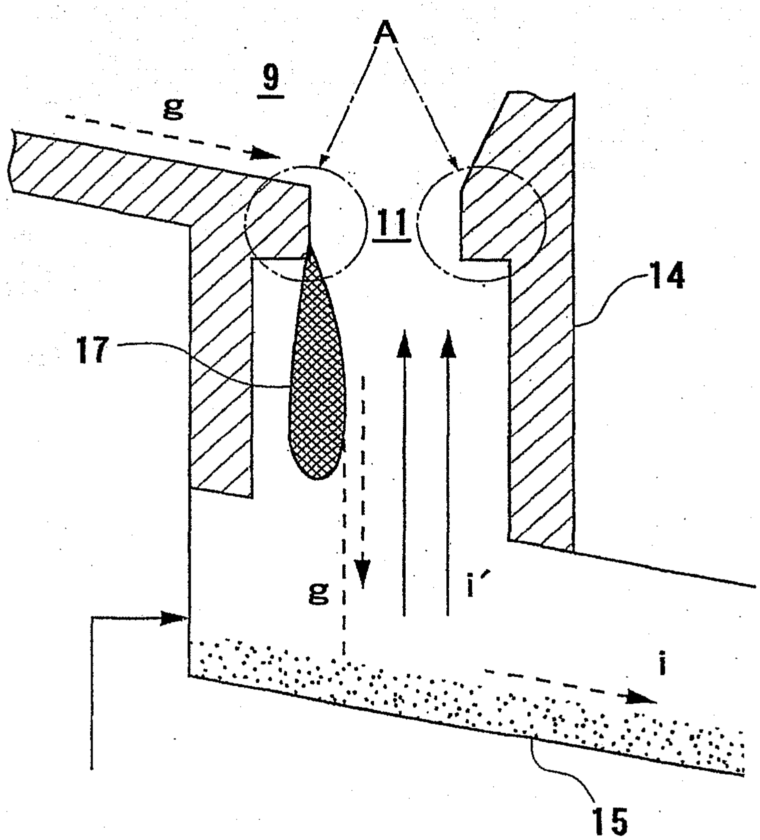
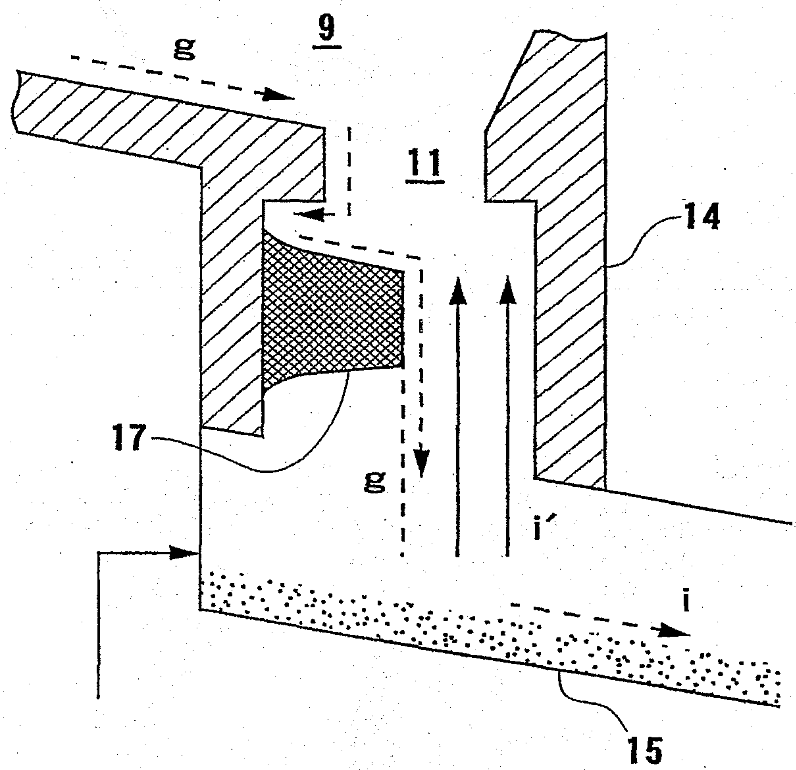


FIG. 7



INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 02/03905

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F23J1/08 F23G5/027

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F23J F23G C10J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
1 July 2002	08/07/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Mougey, M

INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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